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Cities and Growth: In Situ Versus Migratory Human Capital Growth

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Statistics Canada
Micro-economic Analysis Division

Cities and Growth: *In Situ* Versus Migratory Human Capital Growth

Desmond Beckstead, W. Mark Brown* and K. Bruce Newbold‡

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Abstract

University degree holders in large cities are more prevalent and are growing at a more rapid pace than in smaller cities and rural areas. This relatively high rate of growth stems from net migratory flows and/or higher rates of degree attainment in cities. Using data from the 1996 and 2001 Censuses, this paper tests the relative importance of these two sources of human capital growth by decomposing degree-holder growth across cities into net migratory flows (domestic and foreign) and *in situ* growth: that is, growth resulting from higher rates of degree attainment among the resident populations of cities. We find that both sources are important. Hence, it is the ability of cities to both attract and generate degree holders that underlies the high rates of degree attainment we observe across city populations.

Keywords: human capital, degree holders, urban economic growth, regional income disparities

Executive summary

There is a strong, positive and consistent relationship between the population size of a metropolitan area and the share of its population with a university degree. In Canada, the degree-holder share of the rural population was 7% in 2001. This share rises to about 10% for small urban areas with a population from 10,000 to 99,999, and it rises further to just under 15% for medium-sized urban areas with a population from 100,000 to 499,999. For large metropolitan areas, those with a population greater than 500,000, their degree-holder share was, on average, just over 20% (Census 2001).

Human capital, which is often measured by degree holders, has been an important source of growth for cities and a driver of differences in wage levels. Evidence from the United States, for example, clearly shows a positive association between initial levels of human capital and long-run growth. Variation in human capital is also a major determinant of wage differences across cities in France, the United States and Canada. The reason that large cities have higher wage levels is less because their large and industrially diverse economies provide firms with a productive advantage, but more because their populations tend to have invested more in their human capital through formal education.

Given the large and systematic variation in the population share of degree holders across the urban-rural spectrum, and its implications for economic welfare, a natural question is to ask what led to these patterns. It can be argued that growth in human capital can be decomposed into two processes—net migration and *in situ* growth—that work alone or in combination and that might result in one locale having a higher share of human capital than another.

Human-capital growth across cities may be associated with net migratory flows (domestic and foreign), where particular cities may be able to consistently attract more educated workers than they lose through migration. Most recent work that emphasises the role of human capital as a driver of growth, and therefore an important tool for economic development, has implicitly assumed that it is migratory flows that underlie much of the variation in human capital across geographic space. However, there are reasons to believe that the incentives to invest in human capital may vary significantly from place to place.

Although the literature clearly points to the importance of both *in situ* and migratory effects as drivers of human capital growth across cities and rural areas, their relative roles are left largely unanswered. The purpose of this paper is to understand the geographic concentration and growth of human capital across Canada's urban-rural hierarchy. Should research focus on those factors that attract human capital to a city or region, or should the emphasis be placed on those local forces that influence the decisions of individuals to invest in education? Utilizing data from the 1996 and 2001 Censuses, this paper investigates the importance of net migratory flows (domestic

and foreign) and *in situ* growth of human capital. In so doing, it provides a perspective on the importance of these two sources of human capital growth across the urban-rural spectrum.

Perhaps the most striking finding of this paper is that the rates of degree attainment increase with city size. First, there is a clear gradient in degree attainment across the urban-rural hierarchy. The proportion of the population that spent at least the latter part of their formative years in a large urban area and obtained a degree is almost twice that of those that spent their formative years in rural parts of Canada. This provides strong evidence that a large part of the reason for the strong positive association between city size and the share of their populations with degrees is that large cities generate degree holders at a greater rate than smaller cities and rural parts of Canada do. The effect of internal and international migration is to reinforce this pattern.

The relative roles of internal and international migratory flows depend on location along the urban-rural spectrum. For large urban areas, net migratory flows from other parts of Canada play a relatively small role. Moreover, we likely overestimate these net flows because of students who grew up in these larger centres returning home after attending university elsewhere. Hence, unless mobility patterns have changed dramatically over the past 40 years, it is unlikely that the high share of degree holders in large urban areas can be attributed to net internal migration.

Immigration was most important in large urban centres, given the tendency for immigrants to concentrate in a few large cities. Reflective of the emphasis on highly educated and skilled immigrants since the 1990s, net immigration accounts for, on average, 42% of the growth of degree holders. Outside of these large urban areas, immigration contributed far less to human capital change, amounting to 19% in medium centres, 8% in small centres and just 4% in rural areas.

Outside of large urban centres, internal migration plays a much more significant role. All urban-rural classes lose degree holders to large urban centres. From the perspective of these smaller urban and rural areas, these are relatively large flows that substantially reduce the number of degree holders, particularly among the young. This pattern tends to reinforce the effect of low *in situ* rates of growth of degree holders in these places. And yet the impact of these outward flows should be seen as an absolute maximum. Some of these outward flows are made up of degree holders that undoubtedly left large urban centres to obtain their degrees in smaller centres and are merely returning home.

This evidence leads us to conclude that if we are to understand the uneven distribution of human capital, as measured by degree holders in this instance, we have to understand why degree holders chose to move to larger urban centres and, perhaps more importantly, why those who grow up in larger urban areas are more likely to seek postsecondary education. The first question turns on why larger centres are more attractive places to work and live for those with higher levels of human capital. The latter question speaks more to why the motivations and incentives to invest in human capital are different for those that spent their formative years in larger cities. The implication is that human capital may be endogenous to cities and, to the extent that human capital drives economic growth and development, the role of cities as drivers of economic growth looms ever larger.

1 Introduction

There is a strong, positive and consistent relationship between the population size of a metropolitan area and the share of its population that has a university degree. In Canada, the degree-holder share of the rural population was 7% in 2001. This share rose to about 10% for small urban areas with a population from 10,000 to 99,999, and rose further to just under 15% for medium-sized urban areas with a population from 100,000 to 499,999. For large metropolitan areas with a population greater than 500,000, their degree-holder share was on average just above 20% (Census 2001).

Human capital, which is often measured by degree holders[1], has been an important source of growth for cities and a driver of differences in wage levels. Evidence from the United States, for example, clearly shows a positive association between initial levels of human capital and long-run growth (Glaeser, Scheinkman and Shleifer 1995; Glaeser and Saiz 2003; Shapiro 2005). Variation in human capital is also a major determinant of wage differences across cities in France (Gobillion, Duranton and Theiry 2006), the United States (Rosenthal and Strange 2006, Yankow 2006) and Canada (Beckstead et al. 2008). The reason that large cities have higher wage levels is less because their large and industrially diverse economies provide firms with a productive advantage, but more because their populations tend to have invested more in their human capital through formal education.

Given the large and systematic variation in the population share of degree holders across the urban-rural spectrum, as well as its implications for economic welfare, a natural question to ask is what led to these patterns. It can be argued that growth in human capital in any particular location can be decomposed into two processes—net migration and *in situ* growth—that work alone or in combination, and can result in one locale having a higher share of human capital than another.

Variation in human capital growth across cities may be associated with net migratory flows (domestic and foreign), where particular cities are able to consistently attract more educated workers than they lose through migration. Faggian and McCann (2006), for example, note that a recent study conducted by the U.K. Treasury and Department for Trade and Industry found that there were 40% more university graduates employed than were educated in London; conversely, areas in the economically weak north of the U.K. employ fewer graduates than are educated there: this suggests that large scale inter-regional migration flows are capable of shifting human capital geographically. In the Canadian context, domestic migrants are also attracted to Canada's largest urban centres because of higher returns and greater opportunities. At the same time,

1. Degree attainment is used as the measure of human capital in this paper. This is consistent with the literature in which this paper is situated, which relies on the strong association between human capital and higher levels of education. Human capital can also result from experience and other types of educational investment, which are not accounted for in this analysis.

immigrants predominately settle in the same centres and increasingly arrive in Canada with high levels of human capital and advanced degrees.

Most of the recent work that emphasises the role of human capital as a driver of growth and, therefore, as an important tool for economic development (e.g., Florida 2002a, 2002b) has assumed migratory flows underlie much of the variation in human capital across geographic space. However, incentives to invest in human capital can vary significantly from place to place, which can result in significant differences across the urban-rural hierarchy.

Recent literature on educational attainment, for example, notes greater degree attainment in large urban areas. In part, this represents proximity and availability of postsecondary education (Card 1993, Frenette 2002, 2003, 2007), increased returns to education in large urban areas (Bouchard and Zhao 2000, Fortin and Lemieux 2006), historically higher levels of degree holders in urban areas, family expectations and income, and a greater diversity of employment opportunities. In contrast, several studies have shown that rural youth tend to aspire and move into so-called lower-status occupations and they are less likely to attend university (Andres and Looker 2001; Bouchard and Zhao 2000; Christofides, Cirello and Hoy 2001; Finnie, Lascelles and Sweetman 2005; and Looker 2001).

Although the literature clearly points to the importance of *in situ* and migratory effects as drivers of human capital growth across cities and rural areas, the quantitative impact of their relative roles is left largely unexplored. The purpose of this paper is to understand the geographic concentration and growth of human capital across Canada's urban-rural hierarchy. Should research focus on those factors that attract human capital to a city or region, or should the emphasis be placed on those local forces that influence the decisions of individuals to invest in education? Using data from the 1996 and 2001 Censuses, this paper tests the relative importance of net migratory flows (domestic and foreign) and *in situ* growth of human capital. In so doing, we aim to provide an empirical perspective on the relative importance of these two sources of human capital growth across the urban-rural spectrum.

The remainder of the paper is organized as follows. Chapter 2 provides a review of the human capital, migration and education literatures. Chapter 3 briefly reviews national trends in the share of degree holders, and Chapter 4 provides an accounting framework for measuring the components—migratory and *in situ*—of degree-holder growth. Chapter 5 evaluates differences in the growth of degree holders across the urban-rural hierarchy. Chapter 6 discusses the measurement and correlates of *in situ* growth through an analysis of degree attainment by province and place of residence. Chapter 7 concludes the paper.

2 Review of the literature

We start with the assertion that large cities are growing faster in terms of population and employment than are smaller cities and rural areas, with their citizens earning higher incomes and experiencing greater income growth than residents of smaller urban and rural areas (Beckstead and Brown 2006, Polèse and Shearmur 2005). Underlying the growing economic power of cities and their populations are a series of forces, which include changing technologies and falling barriers to trade that have tended to increase the relative demand for highly skilled labour (Yan 2005); rising incomes that enable greater consumption of goods and services (Sanghoon 2005); and, immigration as a source of labour and growth. In combination, these forces may bias growth away from smaller urban or rural areas toward large cities.

Fundamental to the growth of a region is its stock of human capital (see Glaeser 2000). Education and experience are the primary contributors to the accumulation of human capital. From a purely economic perspective, people will invest in an extra year of schooling if they expect that the net present value of their additional earnings from this investment will exceed the forgone income and the out-of-pocket costs (e.g., tuition) of the extra year of education (Fortin and Lemieux 2006). Hence, there are two essential, and countervailing, variables that drive this decision-making process: present value of additional expected earnings; and, costs (opportunity and out-of-pocket). These will tend to vary by location and, as a result, may influence the individual's decision to both invest in more education and to migrate to locations where the returns to such an investment are highest.

Although education and migration are not necessarily exclusionary decisions,[2] we can conceptually define the growth of human capital in a region as the sum of two components. The first is *in situ* growth, whereby growth in human capital is derived from the investments of individuals already situated in a region. The second is through the net effects of migration. That is, human capital can be grown 'within,' or it can migrate to a region as individuals search for new education or employment. Indeed, the intention to enrol in postsecondary can be seen as a human capital issue in which individuals will evaluate their discounted present value of lifetime earnings, net of education costs (Bouchard and Zhao 2000, Fortin and Lemieux 2006). This implies that enrolment will be higher in places with higher returns to a university education. As such, the relative growth rate of human capital across cities and rural regions depends on two factors: decisions of individuals to invest in additional years of education; and, net migratory flows.

Nationally, there is a clear trend toward increased university participation. Full-time university enrolment increased by 29.2% from 1992/93 to 2003/04, although part-time university enrolment

2. Individuals from rural areas will often need to migrate in order to complete a postsecondary education and migration often accompanies the search for post-graduation employment.

declined by 19.4% during the same period. Following the relative expansion of university participation rates over the 1980s, rates stagnated in the 1990s (Fortin 2005), holding steady at approximately 17.5% through much of the 1990s among the 18-to-24-year olds (CAUT 2006). Following 2000, participation rates among the same age group increased to 20.7% by 2003/04.

Despite increased university participation rates since the 1970s (CAUT 2006; Christofides, Cirello and Hoy 2001), several studies have suggested the importance of location relative to degree attainment. Using U.S. data, Blackwell and McLaughlin (1998) note that rural youth aspire to fewer years of education than their urban counterparts, and they typically had lower educational attainment than youth in urban areas. Several authors have recorded similar findings for Canada. Proportionally lower numbers of rural youth complete postsecondary degrees and more drop out of high school. Rural youth tend to aspire to and move into so-called lower-status occupations (fewer professional occupations and more skilled and semi-skilled), they are more likely to report bouts of unemployment, and they are less likely to have full-time, full-year employment (Andres and Looker 2001; Bouchard and Zhao 2000; Christofides, Cirello and Hoy 2001; Finnie, Lascelles and Sweetman 2005; and Looker 2001). Regional differences in university participation are also noted in the literature, with lower participation rates in Quebec, Alberta and Prince Edward Island (Finnie, Laporte and Lascelles 2004).

Historically, high levels of education attainment in large urban areas were seen to result from a higher share of parents with postsecondary education residing in these areas, creating 'built-in' path dependence. However, the presence of a local university also increases participation by increasing the availability of student places and decreasing costs (Frenette 2007). Frenette (2007) noted that the creation of a local university increased local enrolment by 28%, with low-income families benefiting the most, given the expense associated with long-distance residency. Such findings are similar to Card (1993), who found that men who grew up in local labour markets with a nearby college had higher education and earnings than others, with education gains concentrated among those with poorly educated parents—men who would otherwise stop schooling earlier. For those rural youth that do leave their communities to pursue postsecondary education, only a small proportion return, reflective of more restrictive employment or occupational opportunities in their home communities (Looker 2001). Among those that do return, their return makes little difference to the level of human capital in rural areas.

While the financial cost of obtaining a degree may be greater for rural youth, and particularly for those that do not live within commuting distance of a university (Frenette 2007), differences in educational attainment over space are consistently and strongly associated with family advantage (Blackwell and McLaughin 1998). Higher participation rates among youth with parents from high-income families or with high education are consistently noted in the literature, with university participation rates rising as income increases (Drolet 2005; Finnie, Laporte and Lascelles 2004; Finnie, Lascelles and Sweetman 2005; and Looker 2001). Further, Drolet (2005) reports participation rates are more strongly associated with parental education than with income. That is, higher educational levels among parents are associated with increased participation in postsecondary education and a greater likelihood of degree attainment.

Migration may also contribute to the growth of human capital across regions. Specifically, large urban areas potentially have higher shares of degree holders, not just because of higher rates of

degree attainment among people who spent their formative years there, but because of net migratory flows. In fact, the migration literature has long-recognized the role of human capital as a motivator for inter-regional migration. Sjaastad's (1962) human capital theory defines migration as an investment in human capital measured by expected future income, balancing the costs of migration against future expected returns measured by lifetime earnings (see also Milne 1991). If benefits exceed costs, then the individual will migrate to the destination that offers the greatest returns. Both benefits and costs could be monetary (e.g., the dollar cost of moving) or psychic (e.g., the psychological costs of moving away from family and friends), meaning that migration is not exogenously determined.

As such, the human capital theory of migration offers a framework within which both income and non-wage effects enter individual migration decisions, with returns to human capital encouraging migration. Individuals are more likely to select destinations with higher income and employment growth rates (Newbold and Liaw 1994, Shaw 1985), while non-wage components capture the amenities and social or cultural attractions of regions. Moreover, the theory explains why migration rates tend to decline with age, with younger individuals having longer periods within which to capture the benefits (expected income) of migration than their older counterparts.

Following human capital theory, large urban centres are often selected because the returns to education are higher. These higher returns can be related to the more efficient matching between workers skills and firm's needs in larger labour markets, raising the productivity of workers and resulting in higher wages (Helsley and Strange 1990, Kim 1989). These higher returns may also relate to the greater demand for specialized skills in larger urban centres. In part, this may be driven by the labour matching effect and the fact that larger markets allow firms to specialize (Kim 1989). To these more standard economic arguments we can add several others that may also play an important role.

- Power couples: Increasingly, degree holders are marrying degree holders, leading to the need to satisfy the career ambitions of both. One solution is movement to a larger labour market. In so doing, the couple satisfy their career ambitions and maximize family income at the same time (Costa and Kahn 2000).
- City lights effect: Persons with more education will tend to earn higher wages. If cities provide more consumption opportunities, highly skilled/highly paid workers may be drawn to these centres.
- Florida argument: Certain larger cities may be very attractive because they are viewed by the so-called 'creative class' (often defined as degree holders) as being places that are open and welcoming to persons with diverse lifestyles (Florida 2002a, 2002b).

Similar factors also hold true for both new immigrants arriving in Canada and for the foreign born making inter-regional migrations within Canada. The foreign born demonstrate a clear preference for residing in or moving to urban areas. Moreover, the presence of ethnic enclaves and communities, particularly in Canada's main immigrant-receiving cities of Toronto, Montréal and Vancouver, reinforces this attraction while aiding the economic integration of new arrivals (Kobrin and Spear 1983, Newbold 1996).

Although the factors associated with educational attainment in Canada are similar for both domestic- and immigrant-born youth, that is, parental education level, income and occupation (Kao and Tienda 1995; Richmond 1986; Richmond and Kalbach 1980; Vernez and Abrahamse 1996; and White and Glick 2000), immigrants resident in Canada tend to enjoy higher educational attainments than the national average (Hou and Balakrishnan 1996). Compared with native-born youth with a similar socioeconomic status and attendance in a public school in the same neighbourhoods, immigrant youth are also more likely to enrol in postsecondary education and to attend college continuously for four years (Vernez and Abrahamse 1996).

Consequently, the literature clearly points to the importance of both *in situ* and migratory effects as drivers of human capital growth across cities and rural areas. Left largely unexplored is their relative roles and contribution, a question that this paper explores.

3 Patterns in the incidence of degree holders

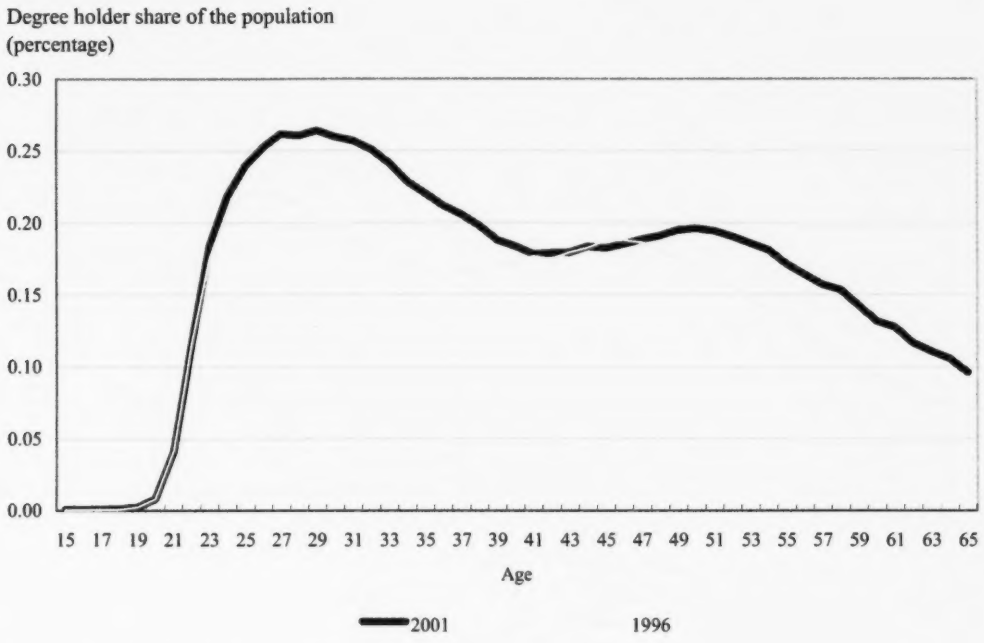
The overarching purpose of this paper is to better understand the relative contributions of migration and *in situ* human capital growth to the wide variation that we observe in the shares of degree holders across urban and rural parts of Canada. Before delving into how the incidence of university-degree holders varies across the urban-rural hierarchy, it is useful to explore national trends, if only to provide a benchmark for urban-rural comparisons.

From 1996 to 2001, the share of degree holders in Canada increased significantly. In 1996, the share of the working-age population (age 15+) with degrees was 13.3%, while this share was 15.4% in 2001 (Censuses 1996 and 2001). Over a relatively short span of five years, the share of degree holders increased by 2.2 percentage points or about 16%.

To see more clearly the dynamics of this process, Figure 1 plots the share of degree holders for persons aged 15 through 65 in 1996 and 2001. Both curves roughly take the shape of a wave, albeit one with two crests. The steep back of the wave consists of persons aged 21 to 25, corresponding to years during which students typically complete their undergraduate university degrees. After age 30, the share of persons with degrees generally declines, which reflects the smaller proportion of older generations that completed university.

Comparing the 1996 and 2001 curves, it is evident that for almost all age classes there is a higher share of degree holders in 2001 than in 1996. This reflects the generally higher rates of degree attainment among the younger generations. The only ages where the curves converge are very young ages, when degree attainment is quite rare, and the 41-to-47 age group, where there has been a lull in the growth of degree attainment.

Figure 1
Degree holder share of employment by age, working age population from 15 to 65, 1996 and 2001

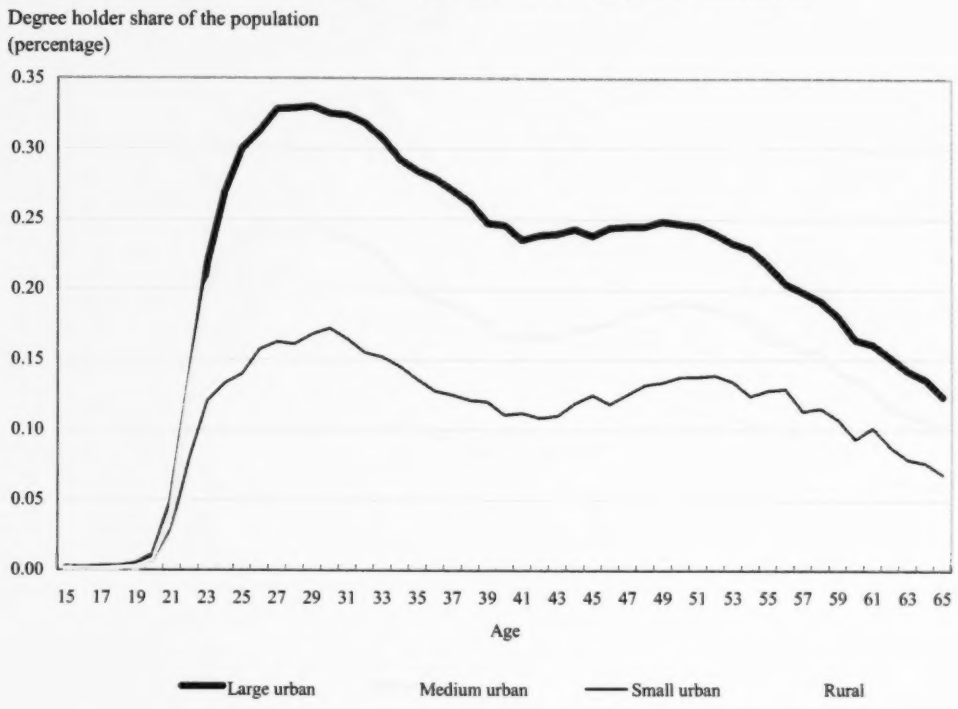


Sources: Statistics Canada, Census of Population, 1996 and 2001.

As there are differences across time, there are also differences in degree-holder incidence across the urban-rural spectrum (see Figure 2). The urban-rural spectrum encompasses large, medium and small urban areas, as well as rural parts of Canada. Large urban areas include census metropolitan areas (CMAs) with a population above 500,000, while medium urban areas are made up of CMAs with a population from 100,000 to 499,999. Small urban areas take in census agglomerations (CAs) with a population greater than 10,000. Rural is defined as non-CMA/CA census subdivisions.

There is an obvious gradient across the urban-rural hierarchy, regardless of age. The highest rate of degree attainment is in large urban areas, and the lowest rate is associated with rural areas. Moreover, this gradient appears to be set to increase over time. To illustrate, the share of degree holders in large urban areas aged 25 is about three times that of rural areas, while for 60-year-old workers, this ratio falls to around two. This strong 'demographic wave' of degree holders for large- and medium-sized cities suggests that the incidence of degree holders between these city-size classes and rural areas may diverge further.

Figure 2
Degree holder share of employment, by age 15 to 65, by city size, 2001



Source: Statistics Canada, Census of Population, 2001.

Together, these figures raise the obvious question of what underlies the significant degree-holder gradient across urban and rural areas. Is it due to higher rates of migration of degree holders to large urban areas, either from elsewhere in Canada or from abroad, or does it derive from higher rates of *in situ* growth?

This is a difficult question to answer, if only because the rates of degree attainment of urban and rural areas reflect the lamination of degree holders that obtained their degrees and/or moved to a particular location decades ago in the past. With census data that spans five years, we cannot explain the incidence of degree holders *per se.* That is, we cannot explain the origins of the entire stock of degree holders. However, using census data we can gain a perspective on why we observe such a wide variation in the incidence of degree holders across the urban-rural hierarchy by observing the flow of degree holders.

To do so, we follow two strategies. One is to decompose the growth in the number of degree holders over the 1996-to-2001 period into that which is due to migratory flows (domestic and international) and that which is due to *in situ* growth of degree holders. To the extent that the lamination of degree holders over this five-year period is representative of past laminations, decomposing growth in this way provides a perspective on the origins of the differences in degree shares of urban and rural areas.

The second strategy involves focusing on persons in their early career stages (ages 20 to 29). It is at these ages that individuals are obtaining their degrees and are most mobile. If we can better understand the sources of growth in these degree holders for urban and rural areas, then we may also gain an understanding of what will drive their future growth.

4 An accounting framework for degree-holder growth

The goal of this paper is to identify the sources of degree-holder growth for a given age cohort within a geographic unit. From the perspective of a city or region, there are three sources of degree holders: net migration from other parts of Canada; net international migration; and, the 'graduation' of individuals from non-degree- to degree-holder status within the resident population or, put more succinctly, *in situ* growth. To identify the relative contribution of these three sources to degree-holder growth, we impose the counterfactual that no degree holders were added to the age cohort over the previous five years; that is, the number of degree holders in year t was the same as that in year t-5. This implies the following: first, no-one migrated—nationally or internationally—into or out of the geographic unit that had, or obtained, a degree over the ensuing five years; second, no-one who remained in the same location obtained a degree.

Our goal is to account for the difference between the actual and counterfactual level of degree holders across locations. This can be accomplished via two related steps. First, we impose the counterfactual that there was no movement of degree holders, and those that obtained degrees from 1996 to 2001, in or out of the geographic unit. This entails eliminating both any form of migration within Canada and any form of international movement of degree holders. For time t, where $t = 2001$, the actual number of degree holders in age cohort c present in location j is given by:

$$D_{jt}^{c} = \sum_{i,i \neq j} M_{ijt}^{c} + I_{jt}^{c} + C_{jt}^{c}, \tag{1.1}$$

where M is the number of migrants from all other locations i to j ($j \in$ Canada), I is the number of immigrants to j from outside of Canada and C is the number of degree holders in j that resided in the same location five years previous. The counterfactual entails sending everyone who left j back to j:

$$\tilde{D}_{jt}^{c} = \sum_{i,i \neq j} M_{jit}^{c} + E_{jt}^{c} + C_{jt}^{c}, \tag{1.2}$$

where the tilde indicates a counterfactual level of degree-holder employment and E is the number of degree holders that emigrated from j. Subtracting (1.2) from (1.1), allows us to define the contributions of net internal migration and international migration to degree holder growth:

$$D_{jt}^{c} - \tilde{D}_{jt}^{c} = \left(\sum_{i,i \neq j} M_{ijt}^{c} - \sum_{i,i \neq j} M_{jit}^{c} \right) + \left(I_{jt}^{c} - E_{jt}^{c} \right). \tag{1.3}$$

In the second step, we impose the additional counterfactual that all persons in age cohort c in j did not obtain a degree; that is, the number of degree holders is the same as the five years previous, D^c_{jt-5}. Subtracting D^c_{jt-5} from (1.2) provides us with a measure of the growth of degree holders that results from the degree attainment:

$$\tilde{D}^c_{jt} - D^c_{jt-5} = \sum_{i,i\neq j} M^c_{jit} + E^c_{jt} + C^c_{jt} - D^c_{jt-5}. \tag{1.4}$$

Since (1.3) plus (1.4) equal $D^c_{jt} - D^c_{jt-5}$, we can define the change in the level of degree holders for a given age cohort between periods as:

$$D^c_{jt} - D^c_{jt-5} = \underbrace{\left(\sum_{i,i\neq j} M^c_{ijt} - \sum_{i,i\neq j} M^c_{jit}\right)}_{\text{net internal migration}} + \underbrace{\left(I^c_{jt} - E^c_{jt}\right)}_{\text{net international migration}} + \underbrace{\sum_{i,i\neq j} M^c_{jit} + E^c_{jt} + C^c_{jt} - D^c_{jt-5}}_{\text{in situ}}. \tag{1.5}$$

The first term of Equation (1.5) accounts for the contribution of net internal migration to the growth of degree holders. The second term measures the effect of net international migration in a similar fashion to the first term. The third and final term measures the influence of *in situ* growth of degree holders; that is, it captures the effect of those persons that obtained degrees over five years, regardless of whether they remained in or left location j. In total, (1.5) provides us with a means to account for the growth of degree holders within an age cohort, and to compare this growth across geographic classes.

The data required to calculate the relative contributions of net internal migration, net international migration and *in situ* growth to changes in the degree share of age cohorts are largely derived from the Censuses of 1996 and 2001. These censuses provide information on the location and educational attainment of individuals. Hence, we can identify university-degree holders (hereafter referred to only as 'degree holders') in 2001 and 1996, and their location.

The 2001 Census also provides information on the location of individuals in 2001 and their location five years previous, allowing for the measurement of the migration of degree holders from 1996 to 2001.[3] From this it is possible to ascertain the census metropolitan area (CMA), census agglomeration (CA), and the province of the individual five years before. Hence, we can identify whether someone migrated to or from a rural area of a province, but little else.[4] In total, we can identify those degree holders that migrated in and out of CMAs, CAs and rural parts of each province. The territories are treated as a whole, with the exception of the CAs of Yellowknife and Whitehorse.

What we cannot measure from these census data are the number of emigrants with degrees. Statistics Canada, however, does provide estimates of the number of emigrants by year, age and

3. These migratory flows will include those persons that had obtained a degree prior to 1996 and those that obtained a degree between 1996 and 2001.
4. We do know from the census whether a person resided in a rural census subdivision that had strong, moderate, weak or no commuting relationships with census metropolitan areas and census agglomerations, but ignore this distinction for this paper.

location.[5] For our purposes, there are two limitations to these data. The first limitation is that the number of degree-holder emigrants is not estimated. To address this limitation, we assume the share of degree-holder emigrants matches that of their corresponding age group and geographic location among the general population in 2001. This is a strong assumption, but we make it with the knowledge that the rate of emigration is relatively low and so any error introduced will have little influence on our overall findings.

The second limitation is that the number of emigrants is tabulated by CMA and province only. Hence, we do not have estimates for CAs or rural areas. To provide estimates for these geographies, we use their provincial population shares to allocate non-CMA provincial emigrants. Since the magnitude of these non-CMA provincial residuals of emigrants is small, we feel that the error in calculating the size of the non-CMA sub-sets will not be of major consequence.

5. Statistics Canada, Demography Division.

5 Differences in the growth of degree holders across the urban-rural hierarchy

Given that the incidence of degree holders differs greatly across urban and rural areas (see Figure 2), it is also true that this gap has been widening over time. From 1996 to 2001, the incidence of degree holders increased the most in large urban areas and the least in rural areas (Table 1). Large urban areas increased their share of degree holders by 2.9% over the period. The increase in share falls to 1.6% for medium urban areas or just a little over half of the increase for that of large urban areas. Small urban areas and rural areas increased their shares the least, 1.1% and 0.9%, respectively, or about one third of the increase in degree-holder share experienced by large urban areas.

Table 1
Degree holder percentage shares across urban and rural classes, 1996 to 2001

Urban and rural classes	1996	2001	Change
	percent		
Large urban	17.3	20.2	2.9
Medium urban	13.1	14.7	1.6
Small urban	8.8	9.9	1.1
Rural	6.6	7.5	0.9
Canada	**13.3**	**15.4**	**2.1**

Note: Degree-holder shares are based on the population of persons age 15 and older.
Sources: Statistics Canada, Census of Population, 1996 and 2001.

Recall that the question at hand concerns the relative roles of *in situ* and net migratory effects as drivers of human capital growth. We start with an aggregate view of the system by considering changes in human capital across the urban-rural hierarchy (Table 2). At the national scale, the number of degree holders increased by nearly 670,000 from 1996 to 2001, with nearly two thirds of the growth in human capital attributed to *in situ* growth, with the remaining one third attributable to immigration, given that there is no net migration effect at the national scale.

Large cities were by far the major beneficiaries of this growth in human capital. While accounting for only 51% of Canada's population aged 20 and above in 2001, large urban areas accounted for almost 75% of the growth in degree holders. The major contributors to this growth are *in situ* and net international migration, which accounted for 50% and 42%, respectively. Net internal migration accounted for only 8% of their growth in degree holders. Hence, the relative strength in the growth of degree holders in large urban areas can be attributed to strong internally generated growth (*in situ*) and international migration effects, but not to internal migration.

Moving down the urban-rural hierarchy, each remaining urban-rural class experienced an increase in degree holders. Net internal migration reduced the stock of degree holders in each of

these regions, particularly medium centres. In total, these lost 23,830 of their degree holders through net internal migration, which amounts to a 35% reduction in the growth of their stock of degree holders. Small urban areas behaved similarly, with internal migration reducing the growth of degree holders by 22%, or 12,545. In both cases, *in situ* growth was the primary source of growth. For rural areas, growth in human capital came exclusively through *in situ* growth; while rural areas had a modest net inflow of immigrants, their contribution to human capital was washed out by out-migration.

Table 2
Components of degree holder growth, numbers and percent, by urban-rural class, 1996 to 2001

Urban and rural classes	Change from 1996 to 2001		Components					
			Net migration		Net immigration		*In situ*	
	Degree holders (percent share of urban-rural class)							
Large	497,776	(100)	38,224	(8)	209,159	(42)	250,392	(50)
Medium	67,979	(100)	-23,830	(-35)	12,799	(19)	79,010	(116)
Small	55,781	(100)	-12,545	(-22)	4,656	(8)	63,670	(114)
Rural	47,694	(100)	-1,849	(-4)	1,875	(4)	47,669	(100)
Canada	**669,230**	**(100)**	**0**	**(0)**	**228,488**	**(34)**	**440,742**	**(66)**

Sources: Statistics Canada, Census of Population, 1996 and 2001.

Much of the growth of degree holders occurs, naturally, at younger ages. Moreover, it is the accumulation of degree holders during the early part of their careers that has the strongest impact on the share of degree holders in a place in the longer run, because mobility tends to decrease with age. Hence, it is important to obtain not only an overall picture of degree-holder growth across urban and rural areas, but also of growth across different age classes. Beyond these reasons for looking at degree-holder growth at different ages, as will become apparent, there are also limitations to our census-based breakdown that influence our conclusions about the significance of internal migratory flows. The growth in degree holders by age group nationally is presented in Table 3.

Table 3
National components of degree holder growth, by age group, 1996 to 2001

Age group in 2001	Change from 1996 to 2001		Components			
			Net immigration		*In situ*	
	Degree holders (percent share of age group total)					
20 to 24	206,796	(100)	7,329	(4)	199,467	(96)
25 to 29	267,192	(100)	35,164	(13)	232,028	(87)
30 to 34	79,339	(100)	59,855	(75)	19,484	(25)
35 to 39	63,629	(100)	53,292	(84)	10,337	(16)
40 to 44	41,318	(100)	33,586	(81)	7,732	(19)
45 to 49	28,840	(100)	21,359	(74)	7,480	(26)
50 to 54	9,972	(100)	8,092	(81)	1,880	(19)
55 to 59	2,507	(100)	2,840	(113)	-333	(-13)
60 to 64	1,697	(100)	2,865	(169)	-1,168	(-39)
65+	-32,060	(100)	4,105	(-13)	-36,165	(113)
Total	669,230	(100)	228,488	(34)	440,742	(66)

Sources: Statistics Canada, Census of Population, 1996 and 2001.

Recalling that *in situ* growth accounted for nearly two thirds of the growth of degree holders nationally, it is quickly evident from the data that the young—the 20-to-24 and 25-to-29 age classes—contribute to over two thirds of this growth. Within these two age groups, 96% and 87%, respectively, of the increase in their share of degree holders comes from *in situ* growth. While the contribution of immigration to human capital growth is modest in these two age groups—4% and 13% for the 20-to-24 and 25-to-29 groups, respectively—its contribution quickly increases among those aged 30 and over. Above the age of 30, immigrants made the largest contributions in all but the oldest age group. In other words, immigration substantially raised the level of human capital throughout most labour force age groups.

Disaggregating by city size complements the results noted above and highlights the differential contributions by age group and across the urban-rural hierarchy (Table 4). Recalling that *in situ* growth contributed 50% of the growth in degree holders in large urban areas, this growth was again largely confined to young adults (aged from 20 to 29). Net domestic migration into large centres enables a modest growth in human capital through most labour force age groups, but net immigration is the most significant contributor, particularly among those aged from 30 to 54, those age groups that capture the majority of recent arrivals. Among older age groups, net migration and *in situ* growth replace immigration as the drivers of human capital growth.

At the other end of the urban-rural spectrum, changes in the level of human capital in rural areas are primarily associated with *in situ* growth. While there is a very modest increase in the level of human capital over that observed in 1996 (47,694), neither immigration nor net internal migration had a significant impact on the level of human capital in these areas, consistent with Looker (2001). However, underneath this general pattern there are some interesting patterns that emerge.

Net internal migration does drive human capital growth in rural areas for those at the start and the end of their careers. For those aged from 20 to 24 there are substantial losses of degree holders. If these newly minted degree holders had stayed, the degree-holder growth would have

risen by 50%. However, for those aged from 30 to 39, net migration turns positive. It is unclear why this is the case, but it may be because degree holders are returning home. For those in the later part of their career—those aged from 50 to 64—we also see a positive effect of net migration, perhaps reflective of return migration to rural areas toward the end of the labour force career or in retirement (Newbold and Bell 2001). Among those aged 65 and over, the decline in human capital is partially attributable to death.

Medium and small urban areas share similar profiles. In both cases, migration and *in situ* growth were the drivers of human capital change. *In situ* dominates the growth of degree holders in medium and small urban areas for younger ages (from 20 to 29) as net international migration is weak and the effect of net internal migration is negative.

Perhaps the most distinctive characteristic of medium and small urban areas is the significant loss of degree holders because of net internal migration among degree holders in their 20s. In other words, had there been no migration out of these communities, the level of human capital would have been much higher. This result likely reflects out-migration of the young from medium urban centres and, to a lesser degree, from small urban centres to large urban centres following completion of their postsecondary education.

This result has to be interpreted with considerable care. On the one hand, the large losses of degree holders from small and medium urban areas suggest that these urban classes are able to generate a large number of degree holders, but that they are unable to retain them as large urban labour markets prove to be far more attractive. On the other hand, we also have to recognize that many of these small- and medium-sized cities may be university towns (for example, Guelph, Kingston or Lethbridge); that is, they specialize in the export of education services. Hence, a place like Kingston may not expect to keep the majority of the degree holders it is able to produce. A telltale sign of this is the larger number of degree holders in the 25-to-29 age group that leave medium urban areas. These degree holders are likely noting on their census forms the place where they were attending university five years before, rather than their home town. In effect, the census is, at least in part, identifying where degree holders obtained their degrees and not where they spent their formative years. In fact, many leaving medium urban areas may be returning home. In this sense, we are observing a 'pass through' effect rather than a loss of the young that grew up in these small urban and medium urban areas. The bottom line is that it is very difficult to interpret the flows of degree holders in the 25-to-29 age group and therefore we should treat it with caution.

A more reliable measure of the effect of migration on degree-holder growth is to focus on the 20-to-24 age group. Five years previous, these new degree holders ranged in age from 15 to 19. Therefore, they are more likely to indicate that they were residing in a place where they spent their formative years, rather than where they attended university.

Looking across the urban-rural hierarchy, the migration of these new graduates follows a distinct pattern. Rural and small urban areas lose a significant number of degree holders, reducing their number of degree holders by 49% and 26%, respectively. Medium urban areas effectively experience no net migratory effect, while large urban areas experience a net positive effect. There, the number of degree holders in the 20-to-24 age group increased by about 11% because

of net internal migration. Based on this group of new university graduates, it is apparent that migration does matter, potentially driving down the incidence of degree holders in the smaller urban and rural parts of Canada. But, although these flows appear to be large for these areas, they amount to just a small fraction of the growth of new graduates in larger urban areas.

In total, two broad patterns emerge in the growth of degree holders across urban and rural areas. The very strong growth in the share of degree holders in large urban areas is driven by relatively high rates of *in situ* growth and immigration. Internal migration plays a much weaker role. In effect, large flows out of medium and small urban areas to large urban areas are swamped by the volume of degree holders generated within large urban areas. In this sense, we cannot account for the high rates of degree attainment in large urban areas by the sorting of degree holders across space, at least within Canada. In medium urban cities, *in situ* growth dominates, and immigration plays only a very minor role. For small urban and rural areas, net migration plays an important role, reducing the number of degree holders in these areas. This raises the question that if there were no migration, would the incidence of degree holders in smaller urban areas and rural areas match that of medium and large urban areas, or do their populations in general obtain degrees at a relatively low rate. This question is addressed in the next chapter.

Table 4
Components of human capital growth, numbers and percent, by urban-rural class and age group, 1996 to 2001

Class and age group	Change from 1996 to 2001		Components					
			Net migration		Net immigration		*In situ*	
	Degree holders (percent share of age group totals)							
Large urban								
20 to 24	133,305	(100)	14,899	(11)	6,779	(5)	111,626	(84)
25 to 29	203,122	(100)	26,048	(13)	32,526	(16)	144,549	(71)
30 to 34	69,761	(100)	5,053	(7)	54,733	(78)	9,975	(14)
35 to 39	50,285	(100)	50	(0)	48,510	(96)	1,725	(3)
40 to 44	34,252	(100)	325	(1)	30,382	(89)	3,545	(10)
45 to 49	21,583	(100)	-75	(0)	19,646	(91)	2,011	(9)
50 to 54	7,328	(100)	-871	(-12)	7,538	(103)	661	(9)
55 to 59	-2,084	(100)	-2,651	(127)	2,628	(-126)	-2,061	(99)
60 to 64	-1,163	(100)	-2,408	(207)	2,648	(-228)	-1,403	(121)
65+	-18,614	(100)	-2,146	(12)	3,768	(-20)	-20,236	(109)
Total	497,776	(100)	38,224	(8)	209,159	(42)	250,392	(50)
Medium urban								
20 to 24	31,681	(100)	32	(0)	415	(1)	31,234	(99)
25 to 29	28,924	(100)	-17,995	(-62)	1,876	(6)	45,043	(156)
30 to 34	3,200	(100)	-4,713	(-147)	3,555	(11)	4,359	(136)
35 to 39	4,928	(100)	-1,135	(-23)	3,110	(63)	2,953	(60)
40 to 44	2,584	(100)	-226	(-9)	2,101	(81)	709	(27)
45 to 49	1,923	(100)	-95	(-5)	1,169	(61)	850	(44)
50 to 54	358	(100)	-150	(-42)	266	(74)	242	(68)
55 to 59	331	(100)	-119	(-36)	57	(17)	394	(119)
60 to 64	-445	(100)	-142	(32)	119	(-27)	-422	(95)
65+	-5,505	(100)	714	(-13)	133	(-2)	-6,351	(115)
Total	67,979	(100)	-23,830	(-35)	12,799	(19)	79,010	(116)
Small urban								
20 to 24	23,934	(100)	-6,117	(-26)	112	(0)	29,939	(125)
25 to 29	20,292	(100)	-7,054	(-35)	610	(3)	26,737	(132)
30 to 34	3,075	(100)	-1,576	(-51)	1,149	(37)	3,501	(114)
35 to 39	3,865	(100)	-23	(-1)	1,177	(30)	2,711	(70)
40 to 44	2,950	(100)	146	(5)	847	(29)	1,957	(66)
45 to 49	2,531	(100)	121	(5)	332	(13)	2,078	(82)
50 to 54	717	(100)	-113	(-16)	126	(18)	706	(99)
55 to 59	660	(100)	326	(49)	97	(15)	236	(36)
60 to 64	1,069	(100)	599	(56)	62	(6)	409	(38)
65+	-3,312	(100)	1,148	(-35)	144	(-4)	-4,604	(139)
Total	55,781	(100)	-12,545	(-22)	4,656	(8)	63,670	(114)
Rural								
20 to 24	17,876	(100)	-8,815	(-49)	22	(0)	26,668	(149)
25 to 29	14,854	(100)	-999	(-7)	153	(1)	15,699	(106)
30 to 34	3,303	(100)	1,237	(37)	418	(13)	1,649	(50)
35 to 39	4,550	(100)	1,108	(24)	496	(11)	2,947	(65)
40 to 44	1,532	(100)	-244	(-16)	255	(17)	1,521	(99)
45 to 49	2,802	(100)	49	(2)	212	(8)	2,541	(91)
50 to 54	1,569	(100)	1,136	(72)	162	(10)	271	(17)
55 to 59	3,600	(100)	2,444	(68)	58	(2)	1,099	(31)
60 to 64	2,236	(100)	1,951	(87)	37	(2)	,248	(11)
65+	-4,629	(100)	284	(-6)	61	(-1)	-4,974	(107)
Total	47,694	(100)	-1,849	(-4)	1,875	(4)	47,669	(100)

Source: Statistics Canada, Census of Population, 1996 and 2001.

6 Measurement and correlates of *in situ* growth

In the preceding analysis, *in situ* growth emerges as an important driver of degree-holder growth, particularly among the young. The intent of this chapter is to evaluate the likelihood of degree attainment relative to the place of residence prior to university. That is, we are interested in whether the relatively low degree shares in small urban and rural areas are due to lower rates of degree attainment among those that spent their formative years in these areas.

To address this issue, we focus on new degree holders aged from 20 to 24 in 2001. We make the implicit assumption that it is the ability of urban and rural areas to create and/or retain these young degree holders that plays a major role in determining their overall degree holder share in the long-run.

To locate degree holders in their place of residence prior to university, we 'relocate' them back to their stated place of residence in 1996. In effect, this means that we are imposing the counterfactual that no persons that obtained a degree left the place where they spent their formative years.

Table 5 illustrates degree attainment across the urban-rural hierarchy, with various age restrictions corresponding to the average age of entry into university by region. We introduce age restrictions in order to better identify individuals that spent their formative years in the location they identified as their residence five years previous. The 'no restriction' case includes all individuals aged from 15 to 19 in 1996 (from 20 to 24 at the time of the census), with their age in 1996 corresponding to a time when they would most likely still be residing in a parental/guardian home prior to university. The group, however, includes persons aged 18 and 19 in 1996. Many of these would be in university, particularly in Atlantic and Western Canada, and may have cited the town where they went to university as where they resided five years previous. The 'low restriction' scenario includes those aged from 16 to 18 in 1996 living in Western Canada and the Atlantic provinces, and aged from 17 to 19 (in 1996) in Ontario and Quebec. Further constraints on age are imposed in the 'high restriction' case, corresponding to entry ages from 16 to 17 in Western and Atlantic Canada and from 17 to 18 in Ontario and Quebec. In short, these age restrictions account for differences in the average starting age for university across provinces. As such, they increase the likelihood that we are capturing the location where degree holders spent their formative years, rather than where they attended university.

Regardless of age restrictions, a clear gradient in degree attainment is observed across the urban-rural hierarchy, with the greatest rate of degree attainment in large urban centres. Nearly similar proportions of individuals resident in medium urban centres attain a degree. Residents of large and medium urban centres are, on average, at least two times more likely to obtain a degree than residents of rural areas.

The results presented in Table 5 illustrate the effect of location on the rate of degree attainment. However, they are limited in the sense that other factors that influence degree attainment are not controlled for. In particular, individual characteristics like age, gender and immigrant status may influence the choice of where and when to obtain a degree. Province of residence may also influence this choice, for example, because of differences in education policies and opportunities. These are, of course, not an exhaustive set of correlates, but they do allow us to 'narrow the field' of factors that might explain why rates of degree attainment vary by 'location' in the urban-rural hierarchy.

Table 5
Percentage share of the late-teen population resident in 1996 that obtained degrees by 2001, by urban-rural class

Urban-rural class	Age class		
	No restriction[1]	Low restriction[2]	High restriction[3]
	percentage		
Large	17	16.4	13.0
Medium	12.1	15.7	12.5
Small	8.9	11.3	9.3
Rural	5.8	7.3	6.1
Canada	**10.3**	**13.3**	**10.6**

1. Aged from 20 to 24 in 2001.
2. Aged from 21 to 23 (Western/Atlantic Canada) and from 22 to 24 (Ontario/Quebec) in 2001.
3. Aged from 21 to 22 (Western/Atlantic Canada) and from 22 to 23 (Ontario/Quebec) in 2001.
Sources: Statistics Canada, Census of Population, 1996 and 2001.

The effect of these correlates on the choice to obtain a degree is estimated through a binary choice (logistic) model (Table 6). Paralleling the tabulations presented in Table 5, three separate models are presented, with Model 1 being the least restrictive in terms of age effects, and Model 3 the most restrictive. Reported are the marginal effects on the probability of obtaining a degree. The reference person is a non-immigrant, non-Aboriginal female living in rural Ontario at about the age of 22. In Model 1 the predicted probability that this person has obtained a degree is 0.072 or 7.2%. The marginal effects of all other variables are made with respect to this predicted probability, with binary variables treated as either 0 or 1.

Turning first to differences across the urban-rural hierarchy, a strong gradient appears that echoes the results obtained earlier. For Model 1, the additional probability of obtaining a degree for residents of large urban centres is, on average, 6.7 percentages points higher than for their rural counterparts. Moving down the hierarchy, the propensity to obtain a degree decreases monotonically, with residents of medium and small urban centres approximately 4.3 and 1.6 percentage points, respectively, more likely to obtain a degree than rural residents. The effect of city size remains qualitatively the same across all three models. Hence, regardless of how we restrict the ages of degree holders, our results remain the same.

Of particular interest is the difference in the probability of obtaining a degree between large urban and medium urban areas.[6] While residents of large and medium urban centres essentially have equal access to universities, the probability of obtaining a degree is higher in large centres than in medium centres. This suggests that the relatively high rates of degree attainment in large urban areas is not just due to ready access to postsecondary education, but is reflective of other characteristics of large urban centres.

6. The null hypothesis that the marginal probabilities of obtaining a degree are the same for large urban and medium urban centres was rejected for all three models at a significance level of 0.0001, or less.

Table 6
Logistic model of the propensity to earn a degree

	Model 1[1]		Model 2[2]		Model 3[3]	
	No restrictions		Low restrictions		High restrictions	
	Marginal probability	P > |z|	Marginal probability	P > |z|	Marginal probability	P > |z|
Age	0.044	<.001	0.058	<.001	0.071	<.001
Immigrant (reference = non)	0.008	0.285	0.006	0.536	0.004	0.720
Male (reference = female)	-0.032	<.001	-0.053	<.001	-0.046	<.001
Aboriginal (reference = non)	-0.056	<.001	-0.094	<.001	-0.075	<.001
City size (reference = rural)						
Large	0.067	<.001	0.096	<.001	0.071	<.001
Medium	0.043	<.001	0.061	<.001	0.041	<.001
Small	0.016	<.001	0.023	<.001	0.020	<.001
Provincial effects (reference = Ontario)						
Newfoundland and Labrador	0.013	0.002	0.027	0.001	0.042	<.001
Prince Edward Island	0.039	0.009	0.082	<.001	0.110	<.001
Nova Scotia	0.046	<.001	0.084	<.001	0.087	<.001
New Brunswick	0.028	0.020	0.057	0.002	0.067	<.001
Quebec	-0.017	<.001	-0.036	<.001	-0.029	<.001
Manitoba	0.002	0.482	0.008	0.261	0.019	0.014
Saskatchewan	0.009	0.116	0.019	0.019	0.023	0.003
Alberta	-0.012	<.001	-0.016	0.001	-0.008	0.072
British Columbia	-0.012	0.016	-0.016	0.062	0.001	0.939
North	-0.033	0.008	-0.042	0.032	-0.031	0.169
Predicted probablity of obtaining a degree[4]	0.072		0.121		0.098	
Number	374,165		239,818		167,485	
Pseudo R-squared	0.13		0.08		0.08	
Log pseudolikelihood	-111,750		-89,821		-54,452	

1. Age from 20 to 24 in 2001.
2. Age from 22 to 24 in 2001 in Quebec and Ontario and from 21 to 23 in 2001 in Atlantic and the West.
3. Age from 22 to 23 in 2001 in Quebec and Ontario and from 21 to 22 in 2001 in Atlantic and the West.
4. The prediction is based on age evaluated at its mean with all other binary variables set to zero. Hence, it is the probability of obtaining a degree for non-immigrant, non-Aboriginal female in rural Ontario at about age 22 for all three models.
Note: P-values have been corrected for heteroskedasticity and correlation across errors within geographic units (metropolitan and rural areas).
Source: Statistics Canada, Census of Population, 2001.

Supporting the broader literature, other effects that modify degree attainment are noted as well. For instance, males and Aboriginals are less likely to obtain a degree. The coefficient associated with males is somewhat surprising, but reflects increased university participation among females over time. Conversely, and not surprisingly, age has a positive effect. There is no significant difference between immigrants and the Canadian born. We do not, however, control for the effect of immigrant parents on the probability of obtaining a degree.

Overall, there exists a clear urban-rural gradient for degree attainment. Location along this gradient can have a significant effect on the probability of obtaining a degree, one that rivals that of Aboriginal status or gender. Hence, part of the reason why we observe a significant difference in the share of degree holders across the urban-rural hierarchy is due to this effect. To the extent that migratory flows of degree holders flow toward larger urban areas, migration will tend to exacerbate these urban-rural differences.

7 Conclusions

The objective of this paper is to shed light on the origins of the strong positive relationship between city size and the incidence of degree holders. This gradient must be due to (1) different rates of degree attainment across the urban-rural spectrum and/or (2) the accumulation of degree holders in larger urban areas through net migration, be it internal or international. Although the variation in the incidence of degree holders reflects a stock of degree holders that has been built up over a long period of time, it is possible to draw some inference about the origins of these differences by observing flows of degree holders, in this case, over a period of five years.

Perhaps the most striking finding of this paper is that rates of degree attainment increase with city size. First, there is a clear gradient in degree attainment across the urban-rural hierarchy. The proportion of the population that spent at least the latter part of their formative years in a large urban area and obtained a degree is almost twice that of rural parts of Canada. This provides strong evidence that a large part of the reason for the strong positive association between city size and the share of their populations with degrees is that large cities generate degree holders at a greater rate than do smaller cities and rural parts of Canada. The effect of internal and international migration is to reinforce this pattern.

The relative roles of internal and international migratory flows depend on location along the urban-rural spectrum. For large urban areas, net migratory flows from other parts of Canada play a relatively small role. Moreover, we likely overestimate these net flows because of students who grew up in these larger centres returning home after having attended university elsewhere. Hence, unless mobility patterns have changed dramatically over the past 40 years, it is unlikely that the high share of degree holders in large urban centres can be attributed to net internal migration.

Immigration was most important in large urban centres, given the tendency for immigrants to concentrate in a few large cities. Reflective of the emphasis on highly educated and skilled immigrants since the 1990s, net immigration accounts for, on average, 42% of the growth of degree holders. Outside of these large urban centres, immigration contributed far less to human capital change, amounting to 19% in medium urban centers, 8% in small urban centres and just 4% in rural areas.

Outside of large urban centres, internal migration plays a much more significant role. All urban-rural classes lose degree holders to large urban centres. From the perspective of these small urban and rural areas, these are relatively large flows that substantially reduce the number of degree holders, particularly among the young. This pattern tends to reinforce the effect of low *in situ* rates of growth of degree holders in these places. Yet the impact of these outward flows should be seen as an absolute maximum. Some of these outward flows are made up of degree

holders that undoubtedly left large urban centres to obtain their degrees in smaller centres and are merely returning home.

This evidence leads us to conclude that if we are to understand the uneven distribution of human capital, as measured by degree holders in this instance, we have to understand why degree holders choose to move to large urban centres but, perhaps more importantly, why those who grow up in larger urban areas are more likely to seek postsecondary education. The first question turns on why large urban centres are more attractive places to work and live in for those with higher levels of human capital. The latter question speaks more to why the motivations and incentives to invest in human capital are different for those that spent their formative years in larger cities. The implication is that human capital may be endogenous to cities and, to the extent that human capital drives economic growth and development, the role of cities as drivers of economic growth looms ever larger.

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